

W75uZmeI

1890/91

UNIVERSITY OF WISCONSIN.

Circular of Information

RELATIVE TO THE

College of Mechanics and Engineering.

MADISON, WISCONSIN:
PUBLISHED BY THE UNIVERSITY.
1891.

Reorganization.

The increase in the instructional force of the College of Mechanics and Engineering for the coming year and the enlargement of facilities are so important as to justify a special announcement. There have been added three entirely new chairs: a professorship of railway engineering, a professorship of electrical engineering and a professorship of machine design, and to these there have been called men of exceptional training and ability. Besides these additions, the work of the existing chairs has been modified and developed so as to give a better division of labor and superior efficiency. The professorship of mechanical engineering becomes centralized upon steam engineering as its leading subject. The theoretical and scientific treatment of electricity and magnetism heretofore falling under the professorship of physics has been developed into a professorship of electricity and magnetism in connection with mathematical physics, and will have for its functions the fundamental scientific treatment of those subjects, while the practical side will be treated by an experienced expert under the professorship of electrical engineering. A professorship of bridge and hydraulic engineering has been developed from the chair of civil engineering and the latter title dropped, because, in the progress of engineering science, it has become too broad and indefinite. The assistant professorship of pure and applied mechanics has been advanced into a full professorship with the slightly modified title of theoretical and applied mechanics. The chair of mechanical practice undergoes no change except an enlargement of facilities. An instructorship in engineering has been added.

These important enlargements and readjustments have been made possible by the passage of the Morrill Act by Congress making a generous appropriation for the specific purpose of instruction in these departments, together with agriculture. This act has also enabled us to add very largely during the past year to the apparatus necessary for the most efficient instruction. This added to the previous excellent outfit renders the appliances of this college among the best in the country.

INSTRUCTIONAL FORCE.

The following are the members of the faculty of the College of Mechanics and Engineering proper, in alphabetical order, to which will be

added the names of the members of the general faculty who give instruction to students in mechanics and engineering in the several subjects indicated by their titles:

STORM BULL, M. E., Professor of Mechanical Engineering.

Born in Bergen, Norway, 1856; M. E. Polytechnic Institute, Zurich, Switzerland, 1877; draughtsman in Marine Engine manufactory, Bergen, Norway, 1877-78; chief draughtsman in same 1878 to 79; instructor in engineering, U. W., 1875 to 1885; assistant professor in mechanical engineering, U. W., 1885 to 1886; Professor Mechanical Engineering U. W. since 1886.

JOHN E. DAVIES, A. M., M. D., L.L. D., Professor of Electricity and Magnetism and Mathematical Physics.

Born in 1839; A. B., Lawrence University, 1862; in the war 1862-65; professor of Physics and Chemistry, Lawrence University, 1865; M. D., Chicago Medical college, 1866; lecturer on chemistry, Chicago Medical college, 1868; professor of Natural History and Chemistry, U. W., 1869 to 1875; professor of Astronomy and Physics, U. W., 1875 to 1879; professor of Physics, U. W., 1879 to 1890; L.L. D., Lawrence University, 1889; professor of Electricity and Magnetism and Mathematical Physics, U. W., 1891.

LEANDER M. HOSKINS, C. E., M. S., Professor of Theoretical and Applied Mechanics.

Born in 1860; B. C. E., U. W., 1883; Morgan fellowship at Harvard, 1884-5; M. S., U. W., 1885; instructor in engineering, U. W., 1885-9; assistant professor of Pure and Applied Mechanics, U. S., 1889-90; professor of Theoretical and Applied Mechanics, U. W., 1891.

DUGALD C. JACKSON, B. S., Professor of Electrical Engineering.

Born 1865; B. S., (Civil Engineering Course) State College, Penn., 1885; fellowship in electricity, Cornell University, 1885-6; assistant in Electrical Laboratory, Cornell University, 1886-7; commercial and engineering work at Lincoln and Omaha, Neb., and New York city, 1887-90; electrical engineer of the Edison Consolidated Co., in charge of central district, Chicago, 1890-91; elected Professor of Electrical Engineering, U. W., July, 1891.

CHARLES I. KING, Professor of Mechanical Practice.

Born in 1849; non-graduate Cornell University; two years' machine work in the south; superintendent of U. W. machine shops, 1877-89; Professor of Mechanical Practice since 1889.

ALBERT W. SMITH, M. E., Professor of Machine Design.

Born 1856; B. M. E., Cornell University, 1878; machinist and contractor with Brown & Sharpe Manf. Co., Providence, R. I., 1879-80; machinist and shop foreman, Straight Line Engine Works, Syracuse, N. Y., 1880-83; superintendent Kingsford Foundry and Machine Works, Oswego, N. Y., 1883-86; M. E., Cornell, 1886; fellowship, Cornell, 1886-7; assistant professor of Mechanical Engineering, Cornell University, 1887-91; elected Professor of Machine Design, U. W., June, 1891.

NELSON O. WHITNEY, E. C., Professor of Railway Engineering.

Born 1858; C. E., University of Penn., 1878; geodetic survey of Penn. and instructor in School of Industrial Art, 1878-9; construction work, office chief engineer, Penn. R. R., 1879-80; locating engineer, Mexican National Ry., 1880-82; locating engineer, South Penn. R. R., 1882-4; resident engineer Tuscarara tunnel; assistant to chief engineer in charge of construction and maintenance, Chicago, 1886-91; elected Professor of Railway Engineering, U. W., June, 1891.

CHARLES B. WING, C. E., Professor of Bridge and Hydraulic Engineering.

Born 1864; C. E., Cornell University, 1886; fellow in civil engineering, Cornell University, 1886-7; instructor in civil engineering, Cornell University, 1887-8; connected with the Berlin Iron Bridge Co., East Berlin, Ct., 1888-9; assistant professor civil engineering, 1890-91; elected Professor of Bridge and Hydraulic Engineering, U. W., August, 1891.

ARTHUR W. RICHTER, M. E., Instructor in Engineering.

Born 1865; B. M. E., University of Wisconsin, 1889; fellow in engineering, U. W., 1889-91; M. E., U. W., 1891; elected Instructor in Engineering, U. W., June, 1891.

The following members of the general faculty give instruction to the students of the College of Mechanics and Engineering in the several subjects indicated by their titles:

W. W. Daniells, M. S., Professor of Chemistry.

H. W. Hillyer, Ph. D., Assistant Professor of Organic Chemistry.

G. C. Comstock, Ph. B., L. L. B., Professor of Astronomy.

C. A. Van Velzer, Ph. D., Professor of Mathematics.

C. S. Slichter, M. S., Assistant Professor of Mathematics.

C. R. Van Hise, M. S., Professor of Archæan and Applied Geology.

R. D. Salisbury, Ph. B., M. A., Professor of General and Geographic Geology.

W. H. Hobbs, Ph. D., Assistant Professor of Mineralogy and Metallurgy.

W. H. Rosenstengel, A. M., Professor of German.

E. T. Owen, A. B., Professor of French.

D. B. Frankenburger, A. M., Professor of Rhetoric.

A. A. Knowlton, A. M., Instructor in Rhetoric.

F. M. Tisdell, B. A., Instructor in Elocution.

H. P. Loomis, Ph. D., Instructor in Physics.

CONTROLLING IDEAS.

The College is organized on the belief that through-going fundamental training is the first essential to a successful engineer, but that this fundamental training may be best secured in connection with a certain amount of study of the practical applications of the principles involved, and not solely by theoretical study. It is further a leading thought that after the fundamental principles have been mastered a certain measure of specialization in the leading lines of engineering is advisable, because of the great development of engineering in recent years and the varied phases which it is rapidly assuming. The day is past when an engineer can be masterful in all departments, and hence an institution may not now content itself with a single general course. It is the endeavor of this institution to combine a prudent amount of specialization in the closing years with a through grounding in the funda-

mentals in the earlier portion of its courses; and in carrying this out, it endeavors to make its mathematical and theoretical courses strong in the earlier years, and its applied courses strong in the later years, while its draughting and shop courses continue progressively from the beginning to the end. It also introduces sufficient foreign language to enable its graduates to read the professional German and French literature and also to give so much of the mastery of the English language as to enable its graduates to present professional subjects with ease, clearness and effectiveness.

COURSES OF STUDY.

A full statement of the courses is contained in the Catalogue of the University, which will be sent to any address on application. The following brief synopses will indicate the general range of the studies offered.

CIVIL ENGINEERING COURSE.

FRESHMAN YEAR.—Mathematics (advanced algebra, plane and spherical trigonometry, analytical geometry and descriptive geometry); practical mechanics (shop work); draughting (elementary and descriptive geometry problems); German or French; rhetoric; rhetorical work; military drill; hygiene.

SOPHOMORE YEAR.—Mathematics, descriptive geometry (analytical geometry, integral and differential calculus); elementary mechanics; physics (experimental lectures); chemistry (lectures, laboratory practice, inorganic analysis); topographical engineering (elementary surveying, field practice); draughting (descriptive geometry problems, topographical), rhetorical work; military drill.

JUNIOR YEAR.—Analytical mechanics; applied mechanics (graphic statics, thermodynamics, mechanics of materials, laboratory work); topographical engineering (elementary, railroad and topographical surveying); constructive engineering (building construction); steam engineering (steam engine); draughting (topographical, platting, graphic statics problems and problems in construction); physics (electricity and magnetism); minerology (general, descriptive, optical, and microscopical); rhetorical work.

SENIOR YEAR.—Engineering (topographical, sanitary, hydraulic); applied mechanics (theory of structures); draughting (designs of iron and steel structures, schemes for ventilation, drainage, etc.); astronomy (practical and engineering applications); geology (theoretical and applied, microscopic petrography), thesis work.

UNIVERSITY OF WISCONSIN.

ANNOUNCEMENT

OF THE

Reorganization of Work in the Classical Departments.

The calling of three new members to the instructional force of the classical departments involves important changes in the division of labor and requires a revised announcement of the courses of study offered and of the professors who will undertake them. The subcourses will remain substantially as announced in the last catalogue, but will be subject to modification by mutual agreement between professors and students. Further developments and rearrangements are contemplated for the year following.

The new appointments are as follows:

PROF. GEORGE L. HENDRICKSON, Professor of Latin.

Born in Winchester, Ill., 1865. A. B., Johns Hopkins University, 1887; Graduate Course, Johns Hopkins, 1887-88; Graduate Course at University of Bonn, Germany, 1888-89; University of Berlin, 1890; Professor of Latin, Colorado College, 1890-91; Elected Professor of Latin, University of Wisconsin, June, 1891.

DR. FRANK LOUIS VAN CLEEF, Professor of Greek.

Born at Wellington, Ohio, 1863. Oberlin College, A. B., 1884; Harvard College, A. M., *magna cum laude*, 1885; three years graduate course in Greek, Latin and Sanskrit, Harvard, 1885-88; Foreign fellowship from Harvard, spent at Bonn, Germany, 1888-90; Ph. D., *cum laude*, in Greek, Latin and Sanskrit, University of Bonn, 1890; Private tutor, Cambridge, Mass., 1890-91; Elected Professor of Greek, University of Wisconsin, July, 1891.

DR. HERBERT C. TOLMAN, Instructor in Latin.

Born at Norwell, Mass., 1865. A. B., Yale University, 1888; Graduate Course, Yale University, Latin and Sanskrit, 1888-90; Ph. D., Yale, 1890; Assistant in Indo-European Languages, Yale, 1890-91; Elected instructor in Latin, University of Wisconsin, June, 1891.

PROF. ALEXANDER KERR, who has occupied the chair of Greek Language and Literature for the past twenty years, is spending the summer in Greece, and will return with fresh acquisitions of knowledge and with rare works and illustrative material.

PROF. W. H. WILLIAMS, who has heretofore divided his instruction between Sanskrit, Hebrew and Greek, will hereafter give his whole time to Sanskrit and Semitic languages.

It is believed that these additions to the instructional force, and the more complete division of labor made possible, will add greatly to the strength and efficiency of these departments.

The subcourses and assignments are as follows:

GREEK.

PROFESSOR KERR AND PROFESSOR VAN CLEEF.

Subcourse I, *Grammar, Prose Composition, Homer*. Designed for students who desire to begin the Greek language, or to review its fundamental principles; especially arranged to meet the wants of Ancient Classical Freshmen who enter the University with advanced standing in other studies, but with inadequate preparation in Greek. It embraces a study of Goodwin's Greek Grammar, Greek Composition, and three books of Homer's Iliad. Five exercises a week, one year. (Prof. Kerr.)

Open to first and second year special students and to undergraduates in any of the regular courses in which Greek is either elective or required.

Subcourse II, *Xenophon's Anabasis, Translation*. Special drill in writing paradigms, and oral exercises in Greek syntax.

This can be taken with or independently of subcourse I. Adapted, as I, for beginners, or for those who have some knowledge of the language but wish to make a thorough review of the essentials of Attic prose. It includes the study of three books of the Anabasis. Special attention given to the analysis of the text, and to the geographical and historical references. Five times a week for one year. (Prof. Van Cleef.)

Elective.

Subcourse III, *Lysias, Homer*. Five orations of Lysias, two books of Homer's Odyssey, Sidgwick's Greek Prose Composition, five times a week during the fall and winter terms. (Prof. Kerr.)

Required of Freshmen in the Ancient Classical Course.

Subcourse IV, *Homer's Odyssey*. Two books; three times a week, spring term. (Prof. Van Cleef.)

Required of Freshmen in the Ancient Classical Course.

Subcourse V, *Herodotus, Lyric Poets*. Book VII of Herodotus, both in prepared lessons and at sight. Selections from the Lyric Poets. Twice a week, fall term; once a week, winter term; five times a week, spring term. (Prof. Kerr.)

Required of Sophomores of the Ancient Classical Course.

Subcourse VI, *Demosthenes, Euripides*. The Olynthiacs of Demosthenes, the Medea of Euripides. Three times a week, fall term; four times a week, winter term. (Prof. Van Cleef.)

Required of Sophomores of the Ancient Classical Course.

Subcourse VII, *Plato's Apology, Crito, Phaedo and Protagoras*. This course is changed every year. Twice a week, fall term; three times a week, winter and spring terms. (Prof. Kerr.)

Elective for students who have completed the required Greek of the Freshman and Sophomore years.

Subcourse VIII, *Derivation of Technical Terms*. Practice in the inflection and formation of words and in elementary composition. Designed to aid students of other departments in the mastery of technical terms of Greek derivation. One-fifth study, winter and spring terms. (Prof. Van Cleef.)

Elective.

Subcourse IX, *New Testament Greek*. Reading of the Gospel and Epistles of John, the peculiarities of New Testament grammar and diction. Twice weekly, three terms.

Elective.

Subcourse X, *Greek Seminary*. Textual criticism and interpretation of the Bacchae of Euripides. Papers upon the antiquities, mythology and literature of the play. Once a week during the year. (Prof. Van Cleef.)

Subcourses III, IV, V and VI are required of candidates for the degree of Bachelor of Arts; elective for other students.

LATIN.

PROFESSOR HENDRICKSON AND DR. TOLMAN.

Subcourse I, *Cicero, Vergil*. Cicero's Orations (four), Vergil's *Æneid* (six books), Latin Composition; five exercises a week during the year. (Dr. Tolman.)

Required of members of the Greek Class; elective for Freshmen of suitable preparation in the English Course.

Subcourse II, *Livy, Cicero*. Livy, Book XXI, Cicero de Senectute, Latin Composition and reading at sight, Roman History in the Epoch Series; five exercises a week during the fall and winter terms. (Dr. Tolman.)

Required of Freshmen in the Modern Classical Course.

Subcourse III, *Livy, Cicero*. Livy, Book XXI, Cicero de Senectute and Select Epistles, Latin Composition and reading at sight, Roman History in the Epoch Series; five exercises a week during the fall and winter terms and two exercises a week during the spring term. (Prof. Hendrickson.)

Required of Freshmen in the Ancient Classical Course; elective for Sophomores of suitable preparation in the English Course.

Subcourse IV, *Horace, Terence*. Horace's Odes, Satires and Epistles, Terence's *Andria*, Roman History in the Epoch Series; two exercises a week during the fall term and three exercises a week during the winter and spring terms. (Prof. Hendrickson.)

Required of Sophomores in the Modern Classical Course.

Subcourse V, *Horace, Plautus, Tacitus*. Horace's Odes, Satires and Epistles, Plautus' *Mostellaria*, Tacitus' *Germania* and *Agrioola*, Latin Composition and reading at sight, Roman History in the Epoch Series; five exercises a week during the year. (Dr. Tolman.)

Required of Sophomores in the Ancient Classical Course.

Subcourse VI, (a) *Terence's Adelphæ and Plautus' Menæchmi*; (b) *Pliny's Letters*; (c) *Lectures on the Private Antiquities of the Romans and the Architectural Remains of the City of Rome*, illustrated by lantern views; three times a week in the fall term and twice a week in the winter and spring terms. (Prof. Hendrickson.) Omitted in 1891-92; will be given in 1892-93.

Elective for Juniors and Seniors in the Ancient and Modern Classical Courses.

Subcourse VII, (a) *Lucretius*, Books I, III, V; (b) *Juvenal and Persius*; (c) *Lectures on the History of Roman Literature*, with Quintilian, Book X, and direction of the student's private reading. (Prof. Hendrickson.)

Elective for Juniors and Seniors in the Ancient and Modern Classical Courses.

Subcourse VIII, *Latin Seminary*. Text Criticism of Tacitus' *Dialogus de Oratoribus*. This course is intended chiefly for graduate students, but will be open to others with the consent of the instructor. The work will be accompanied by the presentation of papers on special topics; one meeting weekly of an hour and a half, counting as a two-fifths study. (Prof. Hendrickson.)

Subcourse IX, *Latin Philology*. Sounds, inflections and syntax of the Latin language from the comparative standpoint, with extracts from Aulus Gellius and Quintilian; twice a week throughout the year. (Prof. Hendrickson.)

Subcourse X, *Teachers' Course*. Methods of teaching Latin in preparatory schools; one exercise a week during the spring term. (Prof. Hendrickson.) Courses in sight reading will be offered.

SANSKRIT.

PROFESSOR WILLIAMS.

Subcourse I, *Perry's Sanskrit Primer and Whitney's Grammar*, twice weekly during the year.

Elective.

Subcourse II, *Reader*, the selections of Larman's *Reader*, twice weekly during the year.

Elective.

SEMITIC LANGUAGES.

PROFESSOR WILLIAMS.

Subcourse I, *Hebrew*, Genesis i-viii, and with these chapters the leading grammatical principles of the language, Pentateuchal poetry twice weekly during the year.

Elective.

Subcourse II, *Hebrew, Linguistic Interpretation* of parts of *Samuel, Isaiah* and the *Psalms*; twice weekly during the year.

Elective.

Subcourse III, *Hebrew Syntax*, recitations and lectures; once weekly during the year.

Elective.

Subcourse IV, *History of Israel*, twice a week during the winter and spring terms.

Elective for all students whether they have pursued the study of the Semitic languages or not.

Instruction is offered in Assyrian (selections in cuneiform text and Lyon's *Assyrian Manual*) and in Arabic (portions of the *Kuran* and *Lansing's Arabic Manual*) if desired by a sufficient number of students to justify it.

These courses may be extended or additional courses offered if desired by a sufficient number of students.

RAILWAY ENGINEERING COURSE.

The Railway Engineering Course is identical with the Civil Engineering Course through the first two years. In the last two years those subjects offered in the Civil Engineering Course which are not important to railway engineers are omitted and Railway Engineering substituted in their stead. Among the special subjects introduced are the following: Railway projects, survey of routes and earthwork computation, economics of railway location, specifications for railway construction and for railway machinery, economics of railway construction, projects and designs, track details, railway maintenance and management, structure and efficiency of locomotive engines, railway jurisprudence, hoisting and pumping machinery, bridge building, engineering architecture and such other subjects as may be found practicable and desirable as the course is developed. The details of the arrangement and development of these are not yet fully determined but will be adjusted as may be found advisable in the growth of the course now fully provided for.

MECHANICAL ENGINEERING COURSE.

FRESHMAN YEAR.—Mathematics (higher algebra, plane and spherical trigonometry, analytical geometry, descriptive geometry); practical mechanics (shop work); draughting (elementary, descriptive geometry problems); German or French; rhetoric; rhetorical work; military drill; hygiene.

SOPHOMORE YEAR.—Mathematics (descriptive geometry, analytical geometry, differential and integral calculus); engineering (elements of machines); practical mechanics (shop work); draughting (descriptive geometry problems, elements of machines); physics (experimental lectures); chemistry (lectures, laboratory practice, inorganic analysis); rhetorical work; military drill.

JUNIOR YEAR.—Engineering (elements of machines, theory of steam engine); mechanics (analytical, graphic statics, mechanics of materials); applied mechanics (thermodynamics); draughting (elements of machines, problems in graphic statics, hoisting machinery); practical mechanics (shop work); rhetorical work.

SENIOR YEAR.—Engineering (construction of steam engine, laboratory work, hydraulic motors); mechanics (mechanics of machinery); practical mechanics (shop work); draughting (pumps, steam engine); metallurgy (fuel, iron and steel); astronomy (practical engineering applications); thesis work.

COURSE IN RAILWAY MECHANICS.

The course in Railway Mechanics consists of the same studies as the Mechanical Engineering Course for the first two years. In the last two years those subjects in the Mechanical Engineering Course that are not important to the railway master mechanic or the superintendent of

motive power are omitted, and subjects relating to railway mechanics substituted for them. The following are among the topics: Structure and efficiency of locomotive engine special types of engines, hoisting machinery and pumps, design for the construction of railway machinery, specifications and contracts for the same, and other subjects relating to the mechanics of railroading.

COURSE IN ELECTRICAL ENGINEERING.

The course in Electrical Engineering is nearly identical with the Mechanical Engineering Course during the first two years, since a large part of what is required in mechanical engineering is necessary to a thoroughly equipped electrical engineer. In the last two years those subjects given in the Mechanical Engineering Course which are not important to the electrical engineer are omitted and electrical studies substituted therefor. As now arranged, the special features of the course begin with physics in the second year and are followed by two consecutive years of electrical study. There is given first a thorough grounding in the science and theory of electricity and magnetism and in electro-dynamics. This is accompanied and followed by electrical measurements and tests of all kinds, standardizing, methods of determining electrical units, economics of electric distribution, electric transmission of power and electric motors, electric locomotives, electric lighting, dynamos, lamps, etc., photometry, management and care of batteries, telegraphy, telephony, electrolosis and electro-metallurgy. Important additions to the course are contemplated.

MINING ENGINEERING COURSE.

This course embraces the leading features of the Civil Engineering Course save that in the last two years mineralogy, metallurgy, assaying, concentration of ores, geology, mine engineering, mines and mine timbering take the leading place in the course.

METALLURGICAL ENGINEERING COURSE.

This is closely similar to the Mining Engineering Course save that in the last two years chemistry, assaying, mineralogy, metallurgy and geology become the leading themes of study.

From the foregoing brief outlines it will be seen that an opportunity is afforded to any student who may be in doubt as to the special line of engineering which it is best for him to adopt, to defer his decision until the close of the Freshman year, since the first year is fundamental to all the courses and is essentially the same. A student may even change his course at the close of the second year with slight disadvantage. At the beginning of the third year the courses diverge into their special lines, and thenceforward each is shaped so as to develop special fitness for the line chosen.

QUARTERS AND EQUIPMENT.

The laboratory, draughting, experimental and class work of the College of Mechanics and Engineering is chiefly provided for upon the two lower floors of Science Hall, one of the finest educational structures in this country. The mechanical practice is carried on in the Machine Shop, a building exclusively devoted to the purpose; the chemistry, assaying, and metallurgical work are carried on in the Chemical Building, a fine structure built especially for the purpose. The work in allied sciences, mineralogy, geology, etc., is conducted upon the upper floors of Science Hall the practical astronomy at the Observatory; the language and mathematical studies in the literary halls of the University. The advantages of association with students seeking general and literary culture, are thus secured.

ENGINEERING LABORATORIES.

The engineering laboratories contain a large variety of apparatus for experimental purposes, among which are the following: Three testing machines made by Tinius Olsen & Co., of 10,000 pounds, 20,000 pounds and 50,000 pounds capacity respectively, provided with tools for making tests in tension, compression, bending and torsion; a Thurston autographic torsion testing machine, a Riehle Bros. cement testing machine of 1,000 pounds capacity, with the necessary clamps and apparatus for measuring and moulding; high and low level tanks of large capacity, fitted for experimenting on and determining the flow of water through orifices and pipes and over weirs; friction brakes of large and small capacity and transmitting dynamometers suitable for carrying out a great variety of tests; a ten-horse power experimental turbine wheel. A ten-horse power vertical steam engine supplies power to the laboratory. There is a fifty-horse power quarter-crank compound engine, so arranged that either cylinder can be supplied with live steam from the boiler and run as a single cylinder engine. The condenser and pumps can also be disconnected so that the engine may be run as a non-condensing one. Both cylinders and the receiver are provided with steam jackets, which may be put out of use at will. By means of a Proell governor the number of revolutions may be varied from 50 to 125. The cylinders have each four puppet valves and the cut-off of the steam is automatically controlled by the governor and may vary between zero and nine-tenths of the stroke. A new fifty-one horse power Root boiler furnishes the steam for this engine exclusively, and will be run in connection with it for the large number of interesting experiments and tests which may be carried out by means of this very perfect engine. There are also the necessary tanks, weighing apparatus, pyrometers, calorimeters, etc., for making complete tests of the economy and capacity of boilers; with a variety of minor and accessory apparatus. The laboratory contains a



large model of Stephenson's link motion, in connection with the piston, cross-head, connecting-rod and crank of engine. It is made in such a way that the dimensions of all the different parts of the model can be changed at will. There is also a small beam engine, with Corliss valve gear, cylinder $4\frac{1}{4}$ " x 9", an Ericsson hot-air engine, a small dynamo, furnishing light to the laboratory, with a small high speed engine furnishing the motive power; a small compound marine engine, with surface condenser and pumps. All these last named machines, including the link motion, have been made by the Seniors in Mechanical Engineering of the last few years. Two lathes (in addition to those in the machine shop) are placed in the laboratory for convenience in preparing specimens for the testing machine.

The engineering museum contains a complete set of Schroeder's models for descriptive geometry, including shades, shadows and perspective; also a small but carefully selected collection of Schroeder's kinematic models, besides a number of smaller models, made by students, illustrative of kinematics.

The draughting room contains a large and varied collection of general working and detailed drawings illustrating a great variety of engineering structures and machines.

The Civil Engineering department is very completely equipped with surveying instruments, gauges, meters, etc. The standard of weights and measures belonging to the state are kept in this department, and all official comparisons are made here.

ELECTRICAL LABORATORIES.

An admirable suite of rooms in Science Hall are devoted to laboratory work in electricity. They are in immediate connection with the physical laboratories and lecture room, which are supplied with an excellent outfit of apparatus of the latest design and most approved manufacture. Among the electrical and magnetic apparatus are a complete set of Sir Wm. Thomson's instruments for electrical measurements, including a new form of magnetometer by Dr. Gray, electro-dynamometers, voltmeters amperemeters, resistance boxes, galvanometers, condensers, and other test instruments for electrical engineering. There are also electrometers by Thompson and Edelman, electric motors, storage batteries, a large Ruhmkorff coil, a Brackett cradle for measuring electrical power, a very full set of Crooke's tubes, switches, standards of electro-motive force, etc. The electric laboratories are connected with the Machine Shop where the dynamos are placed. There are, at present, four of these of different construction and adaptation.

THE ASSAY LABORATORY.

The assay laboratory, situated in the south part of the basement of the chemical building, is well equipped. It has separate rooms for fur-